

Occupational Hepatitis C Virus Infection in Italian Health Care Workers

ABSTRACT

The risk of exposed health care workers in 16 Italian hospitals becoming infected with hepatitis C virus was assessed through two serosurveys at a 1-year interval and at follow-up. Prevalence, which was 2.2%, was significantly associated with previous acute hepatitis, blood transfusions, housekeeping, and older age (>46 years) but not with occupational risk factors. After 1 year, 2622 (87%) of the 3006 seronegative health care workers were retested, and 3 (0.1%), who did not acknowledge occupational or community risk factors, seroconverted. Additionally, 133 (97 needlesticks) out of 370 reported occupational exposures were to hepatitis C virus; one pricked nurse seroconverted (0.75%). Although the risk is not negligible, hepatitis C virus infection does not seem to be easily occupationally transmitted. (*Am J Public Health*. 1995;85:1272-1275)

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Introduction

The risk of acquiring occupational hepatitis B virus and human immunodeficiency virus (HIV) infections has been extensively investigated among health care workers¹⁻³; however, few data are available on the risk of transmission of occupational hepatitis C virus.

This paper reports the results of a study performed by the Italian Study Group on Occupational Risk of HIV Infection³ among participating hospitals to investigate the prevalence and incidence of antibodies to hepatitis C virus among health care workers, according to occupational and community risk factors.

Methods

Entry criteria for a hospital to participate were (1) the presence of a laboratory in which the second-generation hepatitis C virus enzyme immunoassay and RIBA were available and in which an internal quality control system was active; and (2) enrollment of at least two departments among the following specialties: surgery, obstetrics, emergency, infectious diseases, laboratory, and internal medicine.

Sixteen public urban acute-care general hospitals enrolled in the study. Five were teaching hospitals and 12 had an infectious diseases department.

The participating hospitals had a total size of about 21 000 beds (range: 250 to 2500), employed about 28 000 health care workers (range: 350 to 4500), and admitted about 600 000 patients (range: 7600 to 97 000) yearly. A policy of universal precautions and a surveillance program of occupational exposures were active in all the hospitals since 1989.

An initial seroprevalence survey of health care workers was conducted between March and June 1992. Participation in the survey was voluntary, and strict confidentiality was ensured. A clinical follow-up was provided free of charge for workers who tested positive for antibodies to hepatitis C virus.

Sex, age, years of employment, occupation and working department, history of blood transfusions or of viral hepatitis, surgical interventions, and occupational needlesticks were ascertained through confidential interview and review of personal charts. No efforts were made to investigate other risk factors (i.e., sexual behavior or drug abuse).

The health care workers who were seronegative for antibodies to hepatitis C virus at the initial survey were asked to repeat testing after 1 year. Unreported occupational exposure to hepatitis C virus, main community risk factors potentially associated with seroconversion, and clinical history of acute hepatitis were investigated for those workers who seroconverted.

All health care workers who reported an occupational exposure to the virus during the study period were counseled and were clinically and serologically followed both at the time of the exposure and after 6 months. Sera were tested at each hospital using second-generation enzyme immunoassays and were considered positive if specific antibodies were found against at least two hepatitis C virus antigens when retested by a second-generation RIBA.

The protocol was approved by the Istituto Superiore di Sanità of the Italian Ministry of Health in terms of the ethical issues of the study.

The association between seropositivity for hepatitis C virus antibodies and single considered variables was tested using the two-tailed chi-square test or Fishers' Exact Test for categorical vari-

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Editor's Note. See related editorial by Kuller (p 1198) in this issue.

TABLE 1—Risk Variables for Hepatitis C Virus (HCV) Infection in 3073 Health Care Workers from 16 Italian Hospitals

	No. Tested	HCV+ (%)	Odds Ratio	95% Confidence Interval	% Prevalence		% Prevalence	
					Males	Females	Nurses	Housekeeping
Sex								
Female	1979	45 (2.3)	1.0					
Male	1144	22 (1.9)	0.8	0.5, 1.4				
Age, y								
<26	371	4 (1.1)	1.0		2.6	0.9		
26–30	488	9 (1.8)	1.7	0.5, 7.7	2.1	1.8		
31–35	549	8 (1.4)	1.4	0.4, 6.2	1.8	1.3		
36–40	561	6 (1.1)	1.0	0.2, 4.8	0.8	1.2		
41–45	491	10 (2.0)	1.9	0.5, 8.4	0.8	3.4		
>45	613	30 (4.9)	4.7	1.6, 15.9	3.6	6.6		
Length of time in occupation, y								
0–5	896	14 (1.6)	1.0				1.2	4.1
6–10	486	13 (2.7)	1.7	0.7, 4.0			1.7	5.3
11–15	717	13 (1.8)	1.2	0.5, 2.7			1.8	3.5
16–20	548	8 (1.5)	0.9	0.3, 2.4			1.8	1.1
>20	426	19 (4.5)	2.9	1.4, 6.3			3.3	14.5
Blood transfusions								
No	2901	56 (1.9)	1.0					
Yes	172	11 (6.4)	3.5	1.7, 7.0				
Needlestick exposures								
No	1280	23 (1.8)	1.0					
Yes	1793	44 (2.5)	1.4	0.8, 2.4				
Surgery								
No	1250	23 (1.8)	1.0					
Yes	1823	44 (2.4)	1.3	0.8, 2.3				
History of hepatitis								
No	2603	45 (1.7)	1.0					
Yes	470	22 (4.7)	2.8	1.6, 4.8				
Working area								
Medicine	1205	31 (2.6)	1.0					
Infectious diseases	383	4 (1.0)	0.5	0.1, 1.5				
Surgery	909	24 (2.6)	1.0	0.5, 1.8				
Laboratory	371	4 (1.1)	0.4	0.1, 1.2				
Emergency	111	2 (1.8)	0.7	0.1, 2.8				
Obstetric	94	2 (2.1)	0.8	0.1, 3.3				
Job category								
Nurse	1462	28 (1.9)	1.0					
Housekeeper	644	29 (4.5)	2.4	1.4, 4.3				
Surgeon	222	2 (0.9)	0.5	0.05, 1.9				
Laboratory staff	378	3 (0.8)	0.4	0.1, 1.3				
Physician	290	4 (1.4)	0.7	0.2, 2.1				
Midwife	77	1 (1.3)	0.7	0.02, 4.2				
Total	3073	67 (2.2)		1.7, 2.8				

ables. To identify risk factors independently associated with positivity for hepatitis C virus antibodies and to control for confounding, a stepwise logistic regression analysis was performed on those variables that were significantly associated with positivity in the univariate analysis. Odds ratios and 95% confidence intervals (CIs) were calculated. A *P* value of less than .05 was considered significant.

Results

Of the 3236 eligible health care workers, 3073 (95%) were tested, of

whom 67 (2.2%) were found to be positive for hepatitis C virus antibodies. The crude overall hospital-specific seroprevalence rates ranged from 0.4% to 7.5%.

As shown in Table 1, older age, more than 20 years of occupation, a history of blood transfusion or of acute hepatitis, and employment as a housekeeper were significantly associated with a higher seroprevalence rate. Adjustment for potential confounding variables using logistic regression did not alter the results substantially.

Of the 3006 health care workers who tested negative for hepatitis C virus antibodies at the initial survey, 2622

(87%) were retested after 1 year. One male surgeon and two female nurses were found to have seroconverted (0.1%; 95% CI = 0.02%, 0.34%). These workers did not sustain occupational exposures, were unable to identify community risk factors for infection, and had no clinical symptoms of acute hepatitis.

During the study period, 370 occupational exposures were reported (232 needlesticks, 22 cuts, 49 mucous contaminations, and 67 skin contaminations); of these, 133 (97 needlesticks) were from a known positive source for hepatitis C virus antibodies. All the health care workers

exposed to the virus were seronegative at the time of the exposure and were tested 6 months after exposure. Only a 36-year-old female nurse, who sustained a needlestick after blood drawing, seroconverted (0.75%; 95% CI = 0.02%, 4.12%); she denied any community risk factor and did not have clinical symptoms of acute hepatitis.

Discussion

We found that 2.2% of health care workers enrolled in the survey had antibodies to hepatitis C virus. The wide range of crude seroprevalence rates between hospitals reflects the variations in the distribution of virus infection between and within different Italian geographical areas. The regional seroprevalence for virus antibodies assessed in 1990 among 11 000 Italian blood donors ranged from 0 to 1.73%, which is consistent with our results.⁴

As expected, we found that virus seroprevalence increased as a function of previous hepatitis or previous transfusions and, as observed among Italian blood donors,⁴ in association with older age. Conversely, no association was found between positivity for virus antibodies and a history of surgical interventions or occupational needlestick injuries, and the finding of a seroprevalence that increases with the duration of occupation was not confirmed in the adjustment for confounding variables. Moreover, no significant differences were found among job categories and working areas that should pose a different risk of virus exposure. These features suggest that other community risk factors put individuals at risk of acquiring hepatitis C virus infection throughout their life, a finding that is consistent with the lack of an identifiable cause in about 50% of acute hepatitis C virus cases reported in the United States.⁵⁻⁷ Similarly, and as is consistent with data reported by other authors,^{8,9} the high seroprevalence observed among housekeepers probably reflects uninvestigated community risk factors associated with low socioeconomic status, rather than occupational risk factors.

We cannot estimate the risk of hepatitis C virus infection attributable to occupational exposures because no comparable control group exists. However, this does not affect the finding of a lack of association between the occupational risk factors we investigated and the seroprevalence rates for hepatitis C virus antibodies. Other surveys conducted in the

United States¹⁰⁻¹² as well as in Europe¹³⁻¹⁷ have failed to find a significant increase in seroprevalence rates among health care workers that is associated with occupational risk factors, and in some countries, no significant differences were found between the rates among health care workers and those among blood donors of the same geographical area.

We studied a subgroup of health care workers who voluntarily participated in the survey, so there may have been a participation bias. However, we believe that the low proportion of workers who declined to participate should not have affected the internal validity of the study. Additionally, as data were collected through interviews, a recall bias may have occurred; however, this should have been at least partly obviated through a review of personal charts.

Moreover, the health care workers who agreed to participate may have been working in hospitals and facilities where a high degree of adherence to infection control recommendations has been reached. Thus, caution should be taken in generalizing the data to other settings in which different occupational behaviors may put the health care workers at a higher risk of infection.

A certain quota of health care workers found to be positive for hepatitis C virus antibodies could have acquired the infection through personal behaviors associated with a higher risk of infection (i.e., at-risk sexual activity, intravenous drug abuse) that we did not investigate. However, this potential bias should not affect our findings so significantly as to conceal a possible association between rates for hepatitis C virus antibodies and occupational risk factors.

Finally, the lack of sensitivity of the screening test we used could have affected our seroprevalence and seroincidence results. Indeed, it has been observed that molecular assays that were not performed in our study can detect hepatitis C virus genomic RNA in subjects with no detectable immune response against the virus.^{5,18}

In conclusion, despite the need for caution in gleaning inferences from cross-sectional studies, the major reason for the observed low prevalence of hepatitis C virus infection among health care workers is likely to be that the infection is not easily transmitted in health care settings. This is at least partly supported by the low seroconversion rate we found by retesting the workers who were negative for hepatitis C virus antibodies. Indeed, there is no

reason why the three seroconversions we observed could not have been occupationally related; because the survey was repeated after 1 year only, this may have limited the reliability of the observed figure. However, the postexposure seroconversion rate we observed is consistent with other reports showing that the risk of transmission after an occupational needlestick injury ranges from 0 to 3%.¹⁹⁻²³ Only one study found a 10% rate of infection after a needlestick exposure to blood from patients testing positive for hepatitis C virus RNA, an extreme value that was probably owing to differences in study design, diagnostic methods used, and selection of occupational exposures and sources.²⁴

Nevertheless, the possibility of acquiring hepatitis C virus infection after an occupational needlestick has been documented.²¹⁻²⁵ Thus, efforts should be made to reduce the risk of occupational exposures by enhancing the health care workers' adherence to universal precautions and by introducing safer devices and techniques. □

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References

- Centers for Disease Control. Universal precautions for prevention of human immunodeficiency virus, hepatitis B virus, and other bloodborne pathogens in health care settings. *MMWR*. 1988;37:377-382, 387-388.
- Ippolito G, Puro V, De Carli G, and the Italian Study Group on Occupational Risk of HIV Infection. The risk of occupational HIV infection in health care workers:

- Italian multicenter study. *Arch Intern Med.* 1993;153:1451-1458.
3. Tokars JI, Marcus R, Culver DH, et al. Surveillance of HIV infection and zidovudine use among health care workers after occupational exposure to HIV infected blood. *Ann Intern Med.* 1993;118:913-919.
 4. Sirchia C, Almini D, Bellobuono A, et al. Prevalence of hepatitis C virus antibodies in Italian blood donors. *Vox Sang.* 1990;59:26-29.
 5. Alter MJ, Hadler SC, Judson FN, et al. Risk factors for acute non-A, non-B hepatitis in the United States and associations with hepatitis C virus infection. *JAMA.* 1990;264:2231-2235.
 6. Public health service inter-agency guidelines for screening donors of blood, plasma, organs, tissues, and semen for evidence of hepatitis B and hepatitis C. *MMWR.* 1991;40(RR 4).
 7. Alter M. The detection, transmission, and outcome of hepatitis C virus infection. *Infect Agents Dis.* 1993;2:155-166.
 8. Polish LB, Tong MJ, Co RL, Coleman PJ, Alter MJ. Risk factors for hepatitis C virus infection among health care personnel in a community hospital. *Am J Infect Control.* 1993;21:196-200.
 9. Trallero EP, Cilla G, Alcorta M, Elòsegui ME, Sàenz-Domínguez. Bajo riesgo de adquisición del virus de la hepatitis C para el personal sanitario. *Med Clin (Barc).* 1992;99:609-611.
 10. Klein RS, Freeman K, Taylor PE, Stevens C. Occupational risk for hepatitis C infection among New York City dentists. *Lancet.* 1991;338:1540-1542.
 11. Tokars JI, Chamberland M, Shapiro C, et al. Infection with human immunodeficiency virus (HIV), hepatitis B virus (HBV), hepatitis C virus (HCV), among orthopaedic surgeons. Epidemic Intelligence Service, 41st annual conference; 1992; Atlanta, Ga.
 12. Cooper BW, Krusell A, Tilton RC, Goodwin R, Levitz RE. Seroprevalence of antibodies to hepatitis C virus in high-risk hospital personnel. *Infect Control Hosp Epidemiol.* 1992;13:82-85.
 13. Jochen ABB. Occupational acquired hepatitis C infection. *Lancet.* 1992;339:304.
 14. de Luca M, Ascione A, Vacca C, Zarone A. Are health care workers really at risk of HCV infection? *Lancet.* 1992;339:1364-1365.
 15. Di Nardo V, Bonaventura ME, Chiaretti B, Petrosillo N, Puro V, Ippolito G. Low risk of HCV infection in health care workers. *Infection.* 1994;22:115.
 16. Herbert A-M, Walker DM, Davies KJ, Bagg J. Occupationally acquired hepatitis C virus infection. *Lancet.* 1992;339:305.
 17. Zuckerman J, Clewley G, Griffiths P, Cockcroft A. Prevalence of hepatitis C antibodies in clinical health-care workers. *Lancet.* 1994;343:1618-1620.
 18. Rubin RA, Falestiny M, Malet PF. Chronic hepatitis C: advances in diagnostic testing and therapy. *Arch Intern Med.* 1994;154:387-392.
 19. Wormser GP, Forseter G, Joline C, Tupper B, O'Brien TA. Hepatitis C infection in the health care setting: I. low risk from parenteral exposure to blood of human immunodeficiency virus-infected patients. *Am J Infect Control.* 1991;19:237-242.
 20. Petrosillo N, Puro V, Ippolito G, and Italian Study Group on Blood-borne Occupational Risk in Dialysis. Prevalence of hepatitis C antibodies in clinical health-care workers. *Lancet.* 1994;344:339-340.
 21. Kiyosawa K, Sodeyama T, Tanaka E, et al. Hepatitis C in hospital employees with needlestick injuries. *Ann Intern Med.* 1991;115:108-110.
 22. Marranconi F, Mecenero V, Pellizzer GP, et al. HCV infection after accidental needlestick injury in health care workers. *Infection.* 1992;20:111.
 23. Sodeyama T, Kiyosawa K, Urushihara A, et al. Detection of hepatitis C virus markers and hepatitis C virus genomic-RNA after needlestick accidents. *Arch Intern Med.* 1993;153:1565-1572.
 24. Mitsui T, Iwano K, Masuko K, et al. Hepatitis C virus infection in medical personnel after needlestick accident. *Hepatology.* 1991;16:1109-1114.
 25. Vaglia A, Nicolin R, Puro V, Ippolito G, Bettini C, de Lalla F. Needlestick hepatitis C virus seroconversion in a surgeon. *Lancet.* 1990;336:1315-1316.

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